A high-resolution model validation for two north-Alpine flood cases

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High-resolution MM5 simulations for two north-Alpine heavy-precipitation events (20–22 May 1999 and 22–23 August 2005) have been validated against observations from a high-density raingauge network. The reference model setup uses four interactively nested domains with mesh sizes of 27, 9, 3 and 1 km, respectively. Systematic sensitivity tests were conducted with different parameterizations for cloud microphysics and cumulus convection, and experiments with reduced model resolution (3 km and 9 km instead of 1 km) were performed to analyze the resolution-dependence of model skill in the Alpine area. The results indicate that heavy orographic precipitation (storm-totals in excess of about 150 mm) are markedly underestimated with Reisner-Thompson cloud microphysics whereas the Goddard microphysics scheme tends to have a smaller bias. The combination of cumulus parameterizations used in the coarse model domains also has a substantial impact on the verification results, but the optimal configuration of cumulus schemes is found to be different for the two cases investigated here. A thorough analysis indicates that the impact mostly arises from the cumulus scheme used in the 9-km domain because it affects the the track of the cyclone causing the heavy precipitation. The impact on the cyclone track is quite subtle (about 50 - 100 km location difference at a given time), but the ensuing differences in the location and propagation of the precipitation field have a pronounced impact on the validation results due to the quasi-stationary character of the precipitation field in the cases investigated here. Reducing the model resolution from 1 km to 9 km has a large detrimental impact in the Alpine part of the simulation domain because the model is no longer able to capture the small-scale precipitation variability related to the Alpine orography. However, the resolution-dependence of model skill is very small in the Alpine foreland.